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Patients' pre-operative general and specific outcome expectations predict postoperative pain and function after total knee and total hip arthroplasties

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Abstract

Background and aims: Previous studies have suggested there is an association between preoperative expectations about the outcome and outcomes of total knee and total hip arthroplasty (TKA/THA). However, expectations have been rarely examined on their clinical relevance relative to other well-known predictive factors. Furthermore expectations can be measured on a more generic level (e.g. does one expect their symptoms to improve after surgery) or on a more specific level (e.g. does one expect to be able to squat again after surgery). Aim of this study was to examine whether patients' general and specific preoperative outcome expectations predict function and pain 12-months after TKA/THA, when assessed as one of the candidate predictive variables alongside other relevant clinical and sociodemographic variables. Moreover, we explored whether a more generic or a more specific assessment of expectations would better predict outcome.
Methods: A prospective cohort study on consecutive TKA/THA patients, with assessments done preoperatively and 12-months postoperative. Primary outcomes were the knee injury and osteoarthritis outcome score (KOOS) and hip injury and osteoarthritis outcome score (HOOS) activities of daily living (ADL) and pain subscale scores at 12-months. The pain subscales consist of nine-(KOOS) and 10-(HOOS) items and the ADL of 17 items. Patients' preoperative outcome expectations were measured with the credibility expectancy questionnaire (CEQ), which contains three items scored on a 0–9 scale and sum score 0–27 and the Hospital for Special Surgery expectations surveys (HSS expectation surveys) for 17(TKA) or 18(THA) outcomes on 0–4 scale. Other candidate predictors: preoperative pain and function as measured with HOOS/KOOS, sex, age, education level, body mass index, Kellgren/Lawrence score, preoperative mental health and treatment credibility as measured with CEQ. Eight prediction models were constructed using multivariate linear regression analysis with a backward selection procedure.
Results: The 146 TKA patients included in this study had a mean age of 66.9 years (SD 9.2) and 69% was female. The 148 THA patients had a mean age 67.2 (SD 9.5) and 57% was female. Mean outcomes: postoperative HOOS-ADL 84.3 (SD 16.6), pain 88.2 (SD 15.4), KOOS-ADL 83.9 (SD 15.8) and pain 83.6 (SD 17.1). CEQ-expectancy median was in THA 23 (IQR 21;24) and TKA 23 (IQR 20;24). HSS-expectation surveys function was for THA 21.0 (18.0;24.0) and 19.0 (14.0;22.0) in TKA. Patients' outcome expectations were consistently part of the combination of variables that best predicted outcomes for both TKA/THA 1-year post-operatively. Expectations alone explained between 17.0 and 30.3% of the variance in outcomes. The CEQ expectancy subscale explained more variance of postoperative function in TKA and of function and pain in THA as compared to the HSS expectation surveys.
Conclusions: In planning of surgical treatment, orthopedic surgeons should take a range of variables into account of which the patient's expectations about outcome of surgery is one. The CEQ expectancy subscale predicted outcomes slightly better as the HSS expectation surveys, but differences in predictive value of the two measurements

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were too small to prefer between the two. Future studies are advised to replicate these findings and externally validate the models presented.

Keywords: outcome; expectations; total hip arthroplasty; total knee arthroplasty; osteoarthritis; function; pain.

1 Introduction

There is strong evidence that total knee arthroplasty (TKA) and total hip arthroplasty (THA) are cost-effective procedures for alleviating pain and increasing physical function in osteoarthritis patients [1–3]. Although satisfaction rates are generally high, it is estimated that still 7–34% of patients are dissatisfied or report still having pain or physical limitations 6–12 months after surgery [4–6]. The majority of these remaining complaints cannot be explained by technical factors like loosening of the prosthesis. As an increase of the number of joint arthroplasties is expected for the upcoming years [7], absolute numbers of patients with remaining complaints will thus probably also increase. Another recent development is that patients' evaluations of care processes and outcomes play a prominent role in the financial compensations of hospitals. Both these trends make seeking pre-operative factors that can explain outcomes, resulting in a better selection of patients for surgery currently a priority in orthopedics.

One of the factors that may contribute to the variability in outcomes of TKA and THA are patients' expectations about the outcome of surgery [8, 9]. Patients' outcome expectations are defined as "improvements that patients believe will be achieved" [10]. Previously, studies in many fields have shown that these expectations are associated with outcomes [11–13]. In TKA and THA however, mixed results have been found in studies examining the relationship between expectations and outcomes [14, 15]. In previous studies on patients' expectations for TKA and THA the aim has been either to describe and quantify patients' expectations [16, 17] or to investigate the association between preoperative outcome expectations and postoperative outcomes [18–21], or the association between fulfilment of expectations and outcomes [22, 23]. Statistical models presented in these articles have been mainly association models, in which the authors seek to estimate the relationship between expectations and outcomes as accurate as possible. For TKA and THA however many other factors have been found to be also associated with outcomes, for example pre-operative pain and function [24, 25] mental health [25, 26], body mass index (BMI) [27], comorbidity [26], age [24, 25], female gender [25, 27], radiological abnormalities [28]. Probably a combination of these factors best identifies those at risk of poor outcome, rather than just one of these factors. So far, however, patient's expectations have rarely been included as a candidate variable in multivariable prediction models for outcomes of TKA and THA. The first aim of this study therefore is to examine whether expectations have a predictive value when assessed as one of the candidate predictive variables alongside other clinical, demographic and psychosocial predictors that are commonly measured in clinical practice and have been shown to predict post-operative outcomes.

Patients' expectations are a multifaceted and complex construct [29, 30], consequently measurement is challenging. Previous systematic reviews identified that patients' expectations for TKA and THA are measured in many different ways [14, 31]. Some measurement methods are more targeted at very specific (functional) outcomes, while others assess expectations for outcome in a more general sense. Iles et al. [11] found the specificity of the expectation queried to be of influence on the strength of the association between expectations and outcomes. This may be one of the reasons of the variability in the results of the studies examining the relationship between expectations and outcomes in TKA and THA. Therefore, the second aim of this study is to assess whether specificity of the expected outcome assessed influences the predictive value of expectations on outcomes.

2 Methods

2.1 Participants and procedures

This study was part of a larger prospective cohort study on patient reported outcomes of THA and TKA. The larger study included consecutive patients undergoing THA or TKA in the Rijnland Hospital in Leiderdorp, the Netherlands between October 2010 and September 2012.

Assessments were done preoperatively and 12 months after surgery. From July 2011 until September 2012 patients participating in that study received additional pre-operative questions concerning pre-operative expectations about the outcome of surgery, hope and optimism. The larger study, as well as the extension was reviewed and approved by the local hospital Review Board of the Rijnland Hospital, Leiderdorp in the Netherlands (registration number 10/07).

The current paper reports on analyses done with the subset of patients that answered the additional questions. Consecutive eligible patients undergoing a primary TKA or THA were invited by their surgeon to participate in the study. Exclusion criteria were: revision surgery, hemi-arthroplasty, tumor or rheumatoid arthritis, a functioning limiting comorbidity [for example (hemi) paresis], being not sufficiently competent in Dutch to complete a written survey, not being able to manage themselves or not having home care after surgery. Informed consent was obtained from the participants at the time of recruitment.

2.2 Assessments

One day prior to surgery all participants completed a survey including a number of sociodemographic, disease characteristics, patient expectations questionnaires and a number of patient reported outcome measures (PROMs). Approximately 12 months after surgery a survey assessing the same PROMs as pre-operatively was sent to the patients' home address together with a pre-stamped return envelope. If the patient did not return the survey within 3 weeks, we attempted to contact the patient by phone and if necessary we sent another copy of the survey to the patient.

2.3 General outcome expectations and treatment credibility

Expectations about general recovery after surgery were assessed with the expectancy subscale of the credibility expectancy questionnaire (CEQ) which contains three items that are scored on a 0–9 scale and hence the sum score ranges from 0 to 27 [32, 33]. An example of an item is "How much do you really feel that the surgery will help you to reduce your symptoms". Next to outcome expectations the CEQ also contains a credibility subscale. Credibility is defined as "how believable, convincing and logical the treatment is" this concept is closely related to outcome expectations. The credibility subscale also contains three items that are scored on a 0–9 scale.

2.4 Specific outcome expectations

Outcome expectations for 17 (TKA) or 18 (THA) specific outcomes with regard to function and pain of hip or knee (e.g. walking stairs, pain during daytime) were measured with the Hospital for Special Surgery Knee and Hip Replacement and Knee Replacement Expectations Surveys [16, 34], from here on referred to as the HSS expectation surveys (separate questionnaires for TKA and THA). Answering options for all items are scored on a 0–4 scale (4 = back to normal, 3 = much improvement, 2 = somewhat improvement, 1 = small improvement, 0 = do not have this expectation). Principal component analysis with an oblique rotation was used to derive a coherent expectations for post-operative "function" variable from the items of the HSS expectation surveys. For THA items about walking stairs, getting rid of limp, getting in or out of bed chair or car, be able to put on shoes and socks, improve ability to do daily activities in and around the house and improve ability to cut toenails were summed into an "expectations for function" scale. For THA the sum of two items namely relieve of pain during the day, relieve of pain during the night was used as the "pain expectations" scale. Because this variable was highly skewed it was dichotomized in ≤6 and >7 points. For TKA the items about being able to stretch the knee, walking stairs, kneeling down, traveling with public transportation, improving ability to do daily activities in and around the house and being able to change position (sitting down, getting up, etc.) were summed into an "expectations for function" scale. For TKA the HSS expectation survey only contains one pain item which was used as "pain expectations" scale, this item was highly skewed and therefore it was dichotomized in ≤3 and 4 points.

2.5 Pain and function

Pain and function were measured both pre-operatively and 12 months post-operatively with Dutch version of the knee injury and osteoarthritis outcome score (KOOS) [35] and the hip injury and osteoarthritis outcome score (HOOS) [36] pain and activities of daily living (ADL) subscales. The pain subscales consists of respectively nine (KOOS) and 10 (HOOS) items and the ADL subscales consist of 17 items. Sum scores for each subscale are transformed to a 0–100 scale, with 0 representing extreme problems and 100 representing no problems [36, 37].

2.6 Mental health

Mental health was measured with the short form 36 (SF-36), from which the mental component score (SF-36 MCS) was calculated [38, 39]. Scores range from 0 to 100 with a higher score representing better mental health.

2.7 Preoperative radiological severity

Preoperative supine radiographs of hips (anterior-posterior) and weight-bearing radiographs of the knee (posterior-anterior) were collected from the patients' medical record. Radiographs were assessed by an experienced radiologist who was blinded for the side of operation and patient characteristics. The Kellgren and Lawrence (KL) grading system was used to classify the severity of OA. Ten percent of the radiographs were scored twice: the intra-class correlation of the hip radiographs was 99% (95% CI: 85–93%); the intra-class correlation of the knee radiographs was 95% (95% CI: 92–98%). The KL grade in our study was classified as mild in KL 0–2 and severe in KL 3–4.

2.8 Sociodemographic variables and patient characteristics

Education level was scored on a 8-point scale with answering options representing the education levels in The Netherlands, scores were dichotomized in low level (no education to lower vocational education) versus high level (intermediate vocational education to university). Self-reported weight and height were used to calculate BMI.

2.9 Analysis

Multivariate linear regression analyses were employed with postoperative pain (KOOS/HOOS pain) and function (KOOS/HOOS function) as dependent variables. Besides the expectation related variables (general outcome expectations, specific outcome expectations and credibility) we selected seven variables measured preoperatively as candidate predictors of outcome namely preoperative pain, preoperative function, gender, age, education level, BMI, KL score, mental health. The selection of these candidate predictors was based on discussions with orthopedic surgeons about which predictors of outcome they consider in daily practice.

A backwards elimination method was used for these analyses. This procedure started with including all candidate variables in the model, subsequently the least significant variable was removed (the one with the highest *p*-value). The model was thereafter refitted without this variable, and again the least significant variable was removed. This process was repeated until all predictor variables in the model had a *p*-value <0.10.

The models were first ran with the CEQ expectancy subscale as the expectations variable, in case that the CEQ expectancy subscale was included in the final model, this final model was repeated while replacing the CEQ expectancy subscale with the HSS expectation survey subscale corresponding to the outcome of that model (so the HSS expectation function score was used for the models with function as the dependent variable and the HSS expectation pain score was used for the models with pain as the dependent variable). If the CEQ expectancy subscale was not included in the final model, the backwards elimination procedure was completely repeated with the HSS expectation survey score as a candidate predictor instead of the CEQ expectancy score. The R^2 values of the final models were then compared to assess the differences between predictive ability of the models with generic CEQ expectancy subscale and the models with the more specific HSS expectation survey score. All analyses were performed with IBM SPSS Statistics 20 and were done separately for TKA and THA.

3 Results

3.1 Flow of patients and characteristics of the sample

Between July 2011 and September 2012 189 THA and 186 TKA patients were enrolled in the study and completed the additional questions on outcome expectations. In the current study the patients from this subgroup that returned the follow-up questionnaires (146 TKA patients and 148 THA patients) are included. TKA patients included in this study had a mean age of 66.9 years (SD 9.2) and 69% was female, THA patients included in this study had a mean age 67.2 (SD 9.5) and 57% was female. Both the characteristics of the total sample and the subsample included in the current analyses are described in Table 1. The characteristics (age, gender, baseline HOOS and KOOS scores) of the subsample of patients included in current analyses did not differ from those of the total study sample.

3.2 The predictive value of outcome expectations for TKA

Multivariate linear regression models identified BMI, better mental health (SF-36 mental component summary) baseline function (baseline KOOS ADL subscale) and patients' general expectations of outcome (CEQ expectancy) as

Table 1: Patient characteristics and baseline questionnaire scores for the current study population and the overall VESPA study population.

	TKA expectation study (*n*=146)	TKA overall VESPA study (*n*=322)	THA expectation study (*n*=148)	THA overall VESPA study (*n*=343)
Sex, Female (%)	69.0%	70.0%	55.1%	57.0%
Age, mean years (SD)	66.9 (9.3)	66.9 (9.5)	67.5 (8.9)	67.2 (9.5)
Body mass index, mean (SD)	29.5 (4.6)	29.5 (4.5)	27.0 (4.5)	27.1 (4.4)
Education level (%)				
Low	76.1%	73.5%	48.1%	52.0%
High	23.9%	26.5%	51.9%	48.0%
Baseline HOOS (THA) or KOOS (TKA) domain scores				
ADL mean (SD)	46.1 (16.9)	48.8 (17.8)	46.2 (17.7)	44.4 (17.6)
Pain mean (SD)	39.4 (16.2)	41.7 (16.3)	43.9 (18.1)	41.7 (18.2)
12 months post-op HOOS (THA) or KOOS (TKA)domain scores				
ADL mean (SD)	83.9 (15.8)	83.0 (17.6)	84.3 (16.6)	84.9 (17.0)
Pain mean (SD)	83.6 (17.1)	83.7 (18.0)	88.2 (15.4)	87.8 (15.4)
Credibility expectancy questionnaire (CEQ)				
Subscale expectancy, median (IQR)	23 (20;24)	n.a	23 (21;24)	n.a
Subscale credibility, median (IQR)	24 (22;26)	n.a	24 (22;26)	n.a
HSS hip and knee replacement expectation surveys subscale function (range 0–24)	19.0 (14.0;22.0)	18.0 (14.0;21.0)	21.0 (18.0;24.0)	21.0 (17.0;24.0)
HSS hip and knee replacement expectation surveys subscale pain (%) #				
Low	76.1%	69.8%	42.4%	43.8%
High	23.9%	30.2%	57.6%	56.2%
SF36 MCS, mean (SD)	52.8 (10.2)	52.7(10.3)	51.4 (10.0)	51.0 (10.4)
SF36 PCS, mean (SD)	39.4 (7.7)	40.4 (7.4)	39.9 (7.4)	39.9 (7.4)

HOOS = Hip injury and osteoarthritis outcome score (HOOS); KOOS = Knee injury and osteoarthritis outcome score (KOOS); CEQ = credibility expectancy questionnaire; HSS = hospital for special surgery expectation surveys; SF-36 MCS = short form 36 mental component summary; SF-36 PCS = short form 36 physical component summary.

significant predictors of a better (function) KOOS ADL score 12 months post TKA (Table 2). Higher (more positive) scores on the expectation measures predicted more favorable outcomes. The final model explained 30.3% (R^2 0.303) of the variance in outcome. When the CEQ expectancy score was replaced by the more specific expectations measure HSS expectation function subscale the explained variance decreased to 25.2% (R^2 0.252).

For the outcome pain 12 months after TKA, BMI, mental health and patients' general expectations of outcome (CEQ expectancy) were identified as significant predictors (Table 3). The final model explained 17% (R^2 0.170) of the variance of the postoperative pain. When the CEQ expectancy score was replaced by the more specific HSS expectation pain subscale the variance explained slightly improved to 17.7% (R^2 0.177).

Table 2: TKA: final prediction models for the outcome function (KOOS ADL subscale).

Final prediction model for the outcome function [general outcome expectations (CEQ)]				**Final prediction model for the outcome function [specific outcome expectations (HSS)]**			
Variable	**B**	***p*-Value**	**95% CI**	**Variable**	**B**	***p*-Value**	**95% CI**
Preoperative function	0.16	0.04	−1.61; −0.52	Preoperative function	0.14	0.07	−1.64; −0.51
BMI	−1.07	0.00	0.01; 0.31	BMI	−1.07	0.00	−0.01; 0.30
Mental health (SF-36 MSC)	0.41	0.00	0.16; 0.65	Mental health (SF-36 MSC)	0.47	0.00	0.22; 0.72
Outcome expectations (CEQ expectancy)	1.18	0.00	0.39; 1.96	Outcome expectations (HSS Knee Replacement Expectations subscale function)	0.12	0.61	−0.35; 0.60
R^2 for the final model: 0.303				R^2 for the final model: 0.251			

CEQ = credibility expectancy questionnaire; HSS = hospital for special surgery expectation surveys; KOOS = Knee injury and osteoarthritis outcome score (KOOS); B = unstandardized beta coefficient; 95% CI = 95% confidence interval.

Table 3: TKA: final prediction models for the outcome pain (KOOS pain subscale).

Final prediction model for the outcome pain [general outcome expectations (CEQ)]				Final prediction model for the outcome function [specific outcome expectations (HSS)]			
Variable	**B**	***p*-Value**	**95% CI**	**Variable**	**B**	***p*-Value**	**95% CI**
BMI	−1.00	0.00	−1.63; −0.38	BMI	−1.07	0.00	−1.70; −0.43
Mental health	0.42	0.04	0.14; 0.71	Mental health	0.41	0.01	0.13; 0.69
Outcome expectations (CEQ expectancy)	0.80	0.09	−0.11; 1.72	Outcome expectations (HSS Knee Replacement Expectations subscale pain)	6.41	0.05	0.04; 12.77
R^2 for the final model: 0.170				R^2 for the final model: 0.177			

CEQ = credibility expectancy questionnaire; HSS = hospital for special surgery expectation surveys; KOOS = Knee injury and osteoarthritis outcome score; ADL = activities of daily living; B = unstandardized Beta coefficient; 95% CI = 95% confidence interval.

3.3 The predictive value of outcome expectations for THA

Multivariate linear regression models identified baseline function, the KL-score and patients' general expectations of outcome (CEQ expectancy) as significant predictors of function 12 months after THA (Table 4). The final model explained 18.6% (R^2 0.186) of the variance in outcome. When the CEQ expectancy score was replaced by the more specific expectations measure (HSS expectation surveys function subscale) the explained variance slightly decreased to 17.7% (R^2 0.177). For the outcome pain 12 months after THA, baseline function, the KL-score and patients' general expectations of outcome (CEQ expectancy) were identified as significant predictors (Table 5). The final model explained 18.4% (R^2 0.184) of variance

Table 4: THA: final prediction models for the outcome function (HOOS ADL subscale).

Final prediction model for the outcome function in which the general outcome expectations (CEQ) score was included				Final prediction model for the outcome function in which the specific outcome expectations (HSS) score was included			
Variable	**B**	***p*-Value**	**95% CI**	**Variable**	**B**	***p*-Value**	**95% CI**
Age	−0.34	0.042	−0.67; −0.01	Age	−0.34	0.042	−0.675; −0.012
Baseline function (HOOS ADL)	0.31	0.000	0.14; 0.48	Baseline function (HOOS ADL)	0.32	0.000	0.149; 0.485
Kellgren and Lawrence score	4.12	0.09	−0.63; 8.87	Kellgren and Lawrence score	4.10	0.093	−0.693; 8.886
Outcome expectations (CEQ expectancy)	1.23	0.023	0.17; 2.29	Outcome expectations (HSS Hip Replacement Expectations subscale function)	0.732	0.014	0.014; 1.449
R^2 for the final model: 0.186				R^2 for the final model: 0.177			

CEQ = credibility expectancy questionnaire; HSS = hospital for special surgery expectation surveys; HOOS = Hip injury and osteoarthritis outcome score; ADL = activities of daily living; B = unstandardized beta coefficient; 95% CI = 95% confidence interval.

Table 5: THA: final prediction models for the outcome postoperative pain (HOOS Pain subscale).

Final prediction model for the outcome pain in which the general outcome expectations (CEQ) score was included				Final prediction model for the outcome pain in which the specific outcome expectations (HSS) score was included			
Variable	**B**	***p*-Value**	**95% CI**	**Variable**	**B**	***p*-Value**	**95% CI**
Baseline function (HOOS ADL)	0.33	0.00	0.172; 0.0477	Baseline function (HOOS ADL)	0.34	0.000	0.191; 0.496
Kellgren and Lawrence score	3.72	0.090	−0.592; 8.021	Kellgren and Lawrence score	3.89	0.075	−0.399; 8.185
Outcome expectations (CEQ expectancy)	0.98	0.049	0.004; 1.958	Outcome expectations (HSS Hip Replacement Expectations subscale pain)	5.31	0.050	−0.010; 10.620
R^2 for the final model: 0.184				R^2 for the final model: 0.183			

CEQ = credibility expectancy questionnaire; HSS = hospital for special surgery expectation surveys; HOOS = Hip injury and osteoarthritis outcome score; ADL = activities of daily living; B = unstandardized Beta coefficient; 95% CI = 95% confidence interval.

in the outcome. When the CEQ expectancy score was replaced by the more specific expectations measure (HSS expectation surveys pain subscale) the explained variance was similar [18.3% (R^2 0.183)].

4 Discussion

The primary findings of the analyses were 1) that patient expectations for the outcome of THA and TKA consistently are part of a prediction model that predicts the outcomes pain and function 1 year post-operative. 2) that the more general CEQ expectancy subscale explains slightly more variance in function in TKA and function and pain in THA as compared to the HSS TKA or THA expectation surveys.

4.1 Comparisons with the literature

This study is, to the best of our knowledge, the first to assess the predictive value of expectations within a prediction model in which multiple other clinical and sociodemographic variables were entered; we however do want to discuss our results in the light of previous findings regarding patients' outcome expectations for TKA and THA. Several studies have been published that examine the association between pre-operative expectations and outcomes of TKA and THA. These studies analyze their data from an etiological perspective, the aim those studies is to determine whether a particular independent variable really affects the dependent variable, and to estimate the magnitude of that effect [40, 41]. Thus, in such studies patients' expectations are the determinant of interest while other variables are regarded as confounders of the relationship between patients' expectations and outcomes. For these studies contradictive results are found; some studies show a positive associations which suggest that higher expectations are related to better outcomes, others find no association or even negative associations [42]. This variability in results of studies may be caused by the type of expectations examined, the measurement approach used, the outcome assessed, the timing of the outcome assessment or the use of univariate versus multivariate statistical methods [14]. These studies however do not answer the question as to whether patient's expectations can be used in clinical practice to predict the clinical course of the disorder. To answer this question one has to examine whether the predictive value increases by including the expectation variables in the regression analysis. Our study does answer that question by examining expectations within prediction models which "seek to get optimal predictions based on a linear combination of whatever variables are available" [41]. In our study we chose to include candidate variables in the multivariate models that mimic clinical routine, i.e. are easily accessible for professionals because they are already part of regular anamnesis and routine outcome measurement. Our study showed that expectations consistently are part of the set of variables that together best predict the outcomes function and pain 1 year after TKA and THA. Post-hoc we assessed for each model what the amount of explained variance that could be attributed to the expectations measure by running the final prediction models again without the expectations variable and subtracting the R^2 of these models from the R^2 of the final models described in the results section. The amount of variance explained by expectations alone ranged from 1.3 to 6.5%. We suggest that in planning surgical treatment the orthopedic surgeon should take into account not only relative objective measures like age, degree of osteoarthritis and comorbidity but also what the patient thinks to achieve with this THA or TKA surgery. Although these factors seem important they only account for a limited amount of the variance in outcomes. Still, we think that routinely assessing patients' expectations in clinical practice is advisable because besides this predictive role discussing patients' expectations for TKA and THA has more functions in treatment setting. Assessing and discussing patient's expectations is also valuable for patient-practitioner communication and shared decision making [43]. It is further suggested that patients' expectations may be a factor that is causally related to treatment outcome [44]. This could imply that through altering expectations one would be able to achieve better treatment outcomes. Although experimental research with healthy volunteers seems to point in this direction [45, 46], clinical research has not confirmed this as RCT's are scarce and observational studies have found mixed results and cannot fully establish causality [14]. Furthermore, it is still unclear what the most optimal expectation is in clinical situations. Should an expectation be high in order for the non-specific or placebo effects of the intervention to be optimal, or should high expectations for instance be tempered to prevent disappointment?

The second research question of this study examined whether the measurement approach used to measure expectations influenced the predictive value of expectations. Results showed that expectations that were measured with the more general CEQ expectancy subscale predicted most outcomes slightly better than the more outcome specific HSS expectation surveys, specifically for the outcome functioning. However, the differences in predictive value between the CEQ and HSS expectations survey are too small to give a definite answer to the question which one better predicts outcomes. Results do not correspond to those of Iles et al. [11] who found that that the more specific the items of a questionnaire were, the better the predictive value for that outcome. A recent systematic review [31] distinguished between measurement instruments that measured the importance of expectations and measurement instruments that measured the probability that certain events would happen. This review found that measurement instruments that measured probabilities showed better associations with outcomes. It seems like the construct patients' expectations has multiple dimensions that can be measured. In current measurement instruments different combinations of these dimensions are incorporated. Our study assessed whether variations in only one dimension of expectations (specificity of the expected outcome) accounted for differences in predictive values. Further research is needed to identify which dimensions of the construct "patients" outcome expectations' need to be included in the optimal measurement instrument.

4.2 Strengths of the study

This study has several strengths. Firstly, all questionnaires used in this study are well known validated measures that are used in research as well as clinical practice. Secondly, patients were recruited consecutively from one general hospital in The Netherlands. The latter is the setting were most TKA and THA surgeries are performed. The characteristics of our sample are not only comparable to the THA and TKA population of the larger VESPA study) but also very similar to the overall Dutch population of TKA and THA patients in 2011 and 2012 registered in the Dutch Arthroplasty Registry [47] ensuring generalizability of our results.

We chose our candidate variables for the multivariate models based on two criteria, variables had to be associated with outcomes of TKA or THA in previous studies, furthermore they (which is recommended also by several authorities in orthopedics) had to be simple and reliable measures that are already commonly used in clinical practice.

4.3 Limitations of the study

A limitation of this study is that because of the sample size, the number of candidate variables that could be examined was limited. It may therefore be that we have missed important predictive variables. A strength of this study is the use of a continuous predictors and outcome measures. Although some may argue that for clinical practice it is more useful to use dichotomous outcomes and define cut off values for the predictors in the study several methodological studies also have suggested that it is better to not dichotomize in prediction studies as continuous variables contain more information and model fit generally is better with continuous variables [48, 49]. Further, because patient acceptable symptom states have not been established yet for the HOOS and KOOS measures and therefore any cut off point for the outcomes used in this study would be arbitrary. Lastly, to answer the second research question it was necessary to calculate a summary score for the pain and function expectation items of the HSS expectation surveys. However, these questionnaires were developed for the use of the individual item scores, and although in literature all items have been summed before into one total score, factor structures have not been developed officially yet. We therefore did exploratory factor analyses to derive comprehensive "expectations about function" factors. As only one (THA) or two (TKA) items are about pain, we did not run a factor analyses for those items but dichotomized them to get a proper distribution of answers.

5 Conclusion

In conclusion, 1) patients' outcome expectations were consistently part of the combination of variables that best predicted function and pain 12 months postoperatively for both TKA and THA. However, the amount of variance explained by the expectation measures alone was limited. 2) The CEQ expectancy subscale predicted outcomes slightly better as compared to the HSS expectation surveys, but differences in predictive value of the two measurements were too small to recommend the use of one of the two for prediction purposes.

6 Implications

Given the observed importance of patients' outcome expectations, we suggest that in planning surgical treatment orthopedic surgeons should take these, in addition to a broader range of variables, into account of which the patient's expectations about outcome of surgery is one.

Because differences in predictive value of the CEQ expectancy subscale and HSS expectations surveys measurements were very small, future studies are advised to replicate the findings and externally validate the models presented.

Authors' statements
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Informed consent: Written informed consent to participate in the study was obtained from all patients.
Ethical approval: The study protocol was reviewed and approved by the local hospital review board (Rijnland Hospital, Leiderdorp; registration number 10/07), which is affiliated to the Medical Research Ethics Committee of Leiden University Medical Center, Leiden, the Netherlands.

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